Materials Engineering Branch

TIP*

No. 123 An Overview of Optical Fibers

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Optical fibers are usually made of quartz and glass at the present time. However, plastic optical fibers (POFs) have become more popular as new materials in optics and opto-electronics fields. In the 1960s, the DuPont Company introduced polymethyl methacrylate optical fiber (PMMA fiber), also known as Crofon, into the marketplace. DuPont discontinued its manufacture in October 1985, thereby making Japan the holder of more than 95% of the world supply of POF. This TIP is intended only to outline the some of the applications and advantages of POF.

The range of POF's applications includes:

- Light guide.
- Image guide.
- Sensors (Monitoring systems, process controls, with robots).
- Scintillating sensors (e.g., nuclear applications).
- Short distance data transmission (Data links, multiplexers, LAN's).

Features and advantages over silica optical fibers:

- 3 to 10 times larger in diameter.
- 2 to 3 times larger in numerical aperture (Hence they do not require high precision of connectors).
- Hard to break by bending.
- High resistance to impact and vibration.
- Easy to cut and to treat fiber ends.
- Low total cost.

Improvements needed:

- To reduce the high attenuation loss.
- To improve heat resistance.

POF is composed of a plastic fiber core and a cladding (i.e., a coating). The cladding material may be a fluoropolymer or other polymer. The core is made of one of the following plastics:

- Polymethyl methacrylate (PMMA) -- It is the preferred material, giving the best transparency and mechanical properties.

- Polystyrene (PS) -- PS is mainly for scintillating applications often with dye doping. It has better radiation damage resistance. Its mechanical strength is one of its limiting properties.
- Polycarbonate (PC) -- It has good high temperature resistance, but is vulnerable to severe environments (temperature, humidity, and stress combined).

New products are expected to come to the market from time to time. It is important for users to know the manufacturer and the POF specifications. Particular attention should be paid to POF thermal properties and, prior to material selection, the user should be aware of the temperature dependency of the optical properties.

References:

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